

The Douglas Glacier consists of two distinct parts—the glacier proper or valley portion, and the *névé*—which are separated by a rock precipice of magnificent proportions, over 1,000 ft. in height. Above this rock precipice rises a splendid cliff of solid ice, marking the southern face of the *névé*. Every few minutes immense avalanches descend from the face of the *névé* over the rock precipice, and it is mainly their union which produces the valley portion of the Douglas Glacier. The *névé*, which is about three miles and a half long by two miles wide, has a gradual descent from a ridge of inconspicuous peaks lying between the prominent peak of Mount Sefton on the east, and the Sierras—a continuation of the Karangarua Range, with its fine peak of Mount Glorious—on the westward. The surface of the Douglas *névé* shows comparatively few large crevasses, though a large *bergschund* occurs round the eastern base of Mount Sefton. Since the precipice varies in height, and the base of the ice-cliff descends to various altitudes, the actual contact of the *névé* with the rock precipice is not a horizontal line. Sometimes, just after a huge avalanche has broken away, part of the rock beneath is exposed, with a gradual and apparently much-smoothed slope upward from the crest of the precipice. No fewer than thirty-three streams issue from beneath the Douglas *névé*, and descend abruptly as waterfalls.

The valley portion of the Douglas Glacier rises in a spacious cirque near the base of Mount Brunner, and, receiving the ice derived from avalanches from the *névé* all along the great precipice, is a typical reconstructed ice-river. It has a length of about five miles, and exhibits a generally uniform and gradual descent from a point near its source to the frontal face. The surface of the ice is broken by crevasses, roughened by irregular *séracs* and much stacked with moraine.

At the time of our visit the lower part of the Douglas Glacier was well covered by accumulations of an immense avalanche. The soft snow and ice of which it was composed were in places coloured a dull pea-green by comminuted serpentinous rock, evidently derived from the heights to the northward, whence the material came.

Lying between the frontal face of the Douglas Glacier and an old terminal moraine, is a small pond a few hundred yards in length. From this pond the Twain River issues and flows for some miles in narrow flats shrouded in places by old terminal and lateral moraines.

Several tributaries enter the Twain below the frontal face of the glacier, the most important being the Horace Walker Stream. This stream, bordered by prominent fluvio-glacial terraces marking incision in old ground moraine material, flows from the glacier of the same name. The Horace Walker Glacier is a typical valley glacier, relatively narrow and long, and exhibiting beautifully crescentic crevasses across its course. It carries considerable morainic material, but relatively much less than the valley portion of the Douglas. This difference is apparently due mainly to the relatively greater endurance of the crystalline schists through which the Horace Walker passes than that of the friable phyllites and schistose *grauwackes* traversed by the Douglas trunk. It is also undoubtedly partly due to the erosion which takes place along the great precipice, the crest of which is being steadily worn away by the sweep of the enormous weights of avalanche continually descending. The precipice marks the edge of the deeply corrugated valley produced by the ancient and powerful glacier, which descended from the Fitzgerald down the Douglas-Twain Valley to join the Karangarua Glacier. The valley having been much more deeply incised, either by this ice-action or by the pre-existing fluvial action, than that of the tributary ice-stream entering where the Douglas *névé* now lies, the marked discordance in grade at their junction at the great precipice is easily explicable.

A steep hanging valley enters the Twain just below the frontal face of the Douglas on the southern side, and shows along its course many fine ice-smoothed surfaces.

The Karangarua, unlike the Copland, Twain, and Landsborough, cannot be said to rise in a glacier, though its several headwater streams, uniting in the ancient glacial cirque just below Karangarua Pass, do originate in snow-patches, and even small permanent ice-blocks. Formerly, however, a great glacier descended the Karangarua, and, uniting with the various ancient ice-streams of the Twain Valley (still represented by the shrunken Douglas and Fitzgerald glaciers), and of the Copland (now shown by the diminished Marchant and Strauchon glaciers), passed seaward and deployed on the narrow coastal plain—a fact well evidenced by the abundant old moraines near the sea-coast. As this glacier retreated, successive terminal moraines, marking where the recession of the ice was temporarily delayed, were left at various points along the courses of the several streams. These are especially conspicuous in the upper part of the Karangarua, and are in places shown topographically by waterfalls or rapids. These moraines also acted as dams, producing either ponding or at least diminution in the strength of the current behind them. The aggradation of these stretches of slackened water has produced the numerous flats on the Karangarua. It is quite possible that the aggradation of the glaciated valley proceeded synchronously with the gradual retreat of the ice.

Evidently the corrasion of the old Karangarua Valley floor by the Karangarua Glacier was not uniform, since at approximately the same altitude occur both rock gorges and gravel-filled flats with terraces, which, as mentioned before, represent aggraded areas. It may be, however, that in some cases warping has altered the valley-grades, and so produced the flats under discussion. Both the gorges and the terraces exhibit the dissection by the rivers beneath the valley-floor as it was when the glacier retreated. The meanderings of the stream across the aggraded gravel stretches brings the course in places on either side against the old rock wall of the valley. Thus gravel bars alternate with rock cliffs often overhanging on either side of the stream.

The Cataracts are the most conspicuous waterfalls on the Karangarua itself, and mark the point where the river descends over a marked ancient terminal moraine. Cassell's Flat, which marks the point where the ancient main Karangarua, Twain, and Regina Creek glaciers formerly united, is the largest flat, but there are many others above this point on the Karangarua.